engineered metal film (i.e., a metal film fabricated such that its lower portions have a higher internal compressive stress than its upper portions) that is at least partially formed on a release material layer. The present inventors recognized that most failures of spring structures (e.g., separation of the spring structure from an underlying substrate through delamination or peeling) occur a significant amount of time after fabrication, and believe these failures are caused at least in part by the internal stress gradient retained in the anchor portion of the spring metal finger. To counter the peeling effect produced by the internal stress gradient of the spring metal finger, Applicants' invention introduces a stress-balancing pad formed on the unlifted anchor portion of the spring metal finger, where the stress-balancing pad is formed with an internal stress gradient that is opposite in sign to the internal stress gradient of the spring metal finger. The opposite internal stress gradient is illustrated in Applicants' Fig. 4, which is reproduced below for reference, along with corresponding text from Applicants' specification (paragraph 0029, page 12):

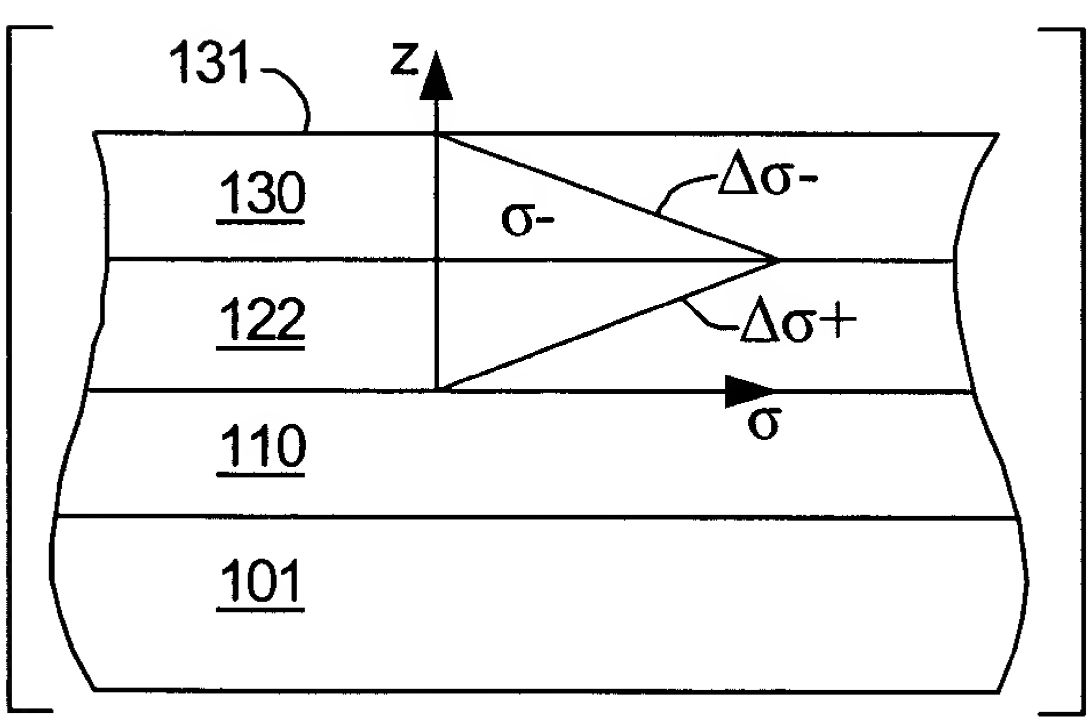

FIG. 4

Fig. 4 is partial side view in which internal stress gradients are superimposed over portions of anchor portion 122 and stress-balancing pad 130. As indicated in the lower portion of Fig. 4, anchor portion 122 is etched from a stress-engineered metal film that has a positive stress gradient Δσ+ (i.e., tending to bend the edges of anchor portion 122 away from substrate 101), whereas stress-balancing pad 130 is etched from a stress-engineered metal film that has a negative stress gradient Δσ- (i.e., tending to bend the edges of stress-balancing pad 130 downward toward substrate 101).

The opposite internal stress gradient provided by the

stress-balancing pad causes the stress-balancing pad to apply a downward force on the edges of the anchor portion of the spring metal finger, thereby resisting the delamination or peeling of the anchor portion that can result in separation from an underlying substrate.

Original Rejection Under 35 USC 102

Claims 1-9, 11-15, and 17-19 are rejected under 35 USC 102(b) as being anticipated by Fork (USP 6,290,510). Regarding Claim 1, the Examiner maintains the following rejection (reproduced in pertinent part):

> Referring to claim 1, a spring structure comprising…a stress-balancing pad (Fig. 6 #638-1), formed on the anchor… wherein the stress-balancing pad…has a second internal stress gradient (col. 9 Lines 62-63, where the stress-balancing pad is secured to the substrate and has the opposite stress than the spring metal finger, which the spring metal finger pulls away from the substrate and can be seen in Fig 6), that is opposite to the first internal stress gradient, (Col. 5 Lines 25-34).

Applicants respectfully point out that the common definition of "gradient" in the present context is a change in the value of a quantity (e.g., temperature, pressure, or concentration) with change in a given variable and especially per unit distance in a specified direction. As used with reference to the present invention, the term "gradient" is related to a change in the internal stress with a change in film thickness. Referring again to Applicants' Fig. 4 (reproduced above), the positive internal stress gradient in anchor portion 122 increases from a minimum to a maximum value in the positive z-axis direction, and the negative internal stress gradient in stress-balancing pad 130 decreases from a maximum value to a

minimum value in the positive z-axis direction. Applicants' specification further teaches that one method to generate these opposite internal stress gradients is to utilize fabrication parameters (e.g., deposition chamber pressure variations) that are altered in manner opposite to those used to form the spring metal layer/anchor portion:

> Spring metal finger 120 is etched from a stress-engineered metal film that is deposited by DC magnetron sputtering one or more metals using gas (e.g., Argon) pressure variations in the sputter environment during film growth. These pressure variations are controlled using known techniques to generate an internal stress gradient that causes claw 125 to bend away from substrate 101 when an underlying release material is removed. (Paragraph 0026, page 11, near top.)
>
> However, stress-balancing pad 130 is formed using a pressure variation sequence that is opposite to that utilized to generate spring metal finger 120, thereby causing stress-balancing pad 130 to include an internal stress that is opposite to that provided in spring metal finger 120. (Paragraph 0028, page 11, near bottom.)

The pending rejection of Claim 1 is traversed because Fork teaches neither that plated metal portion 638-1 includes "an internal stress gradient", nor that the "internal stress gradient" of plated metal portion 638-1 is opposite to the first internal stress gradient" provided in the anchor portion of the spring metal finger. As pointed out above, to generate "an internal stress gradient", a pressure variation sequence (or other stress varying procedure) must be utilized during the formation of plated metal portion 638-1. The text and figures of Fork that are relied upon by the Examiner fail to even remotely suggest either that plated metal portion 638-1 includes an internal stress gradient, or that a pressure variation

sequence (or other stress varying procedure) is utilized in the formation of plated metal portion 638-1. Specifically, Fork's column 9, lines 62-63 (which are specifically relied upon by the Examiner) only mention the formation of plated metal portion 638-1 for improving electrical conductance:

9

The resulting spring structure **600** is shown in FIG. **6**(H). Note that some of passivation metal portion **630-1** (or plating metal if no passivation metal is used) is optionally retained on spring metal finger **620-1**F to improve electrical conduction and/or improve contact resistance. In addition, portions **638-1** of the plated metal are retained on all spring metal that remains secured to the substrate, thereby improving electrical conductance. Note also that the side edges of anchor portion **622** (and underlying release material portion **612**) are self-aligned to plated material portion **638-1**.

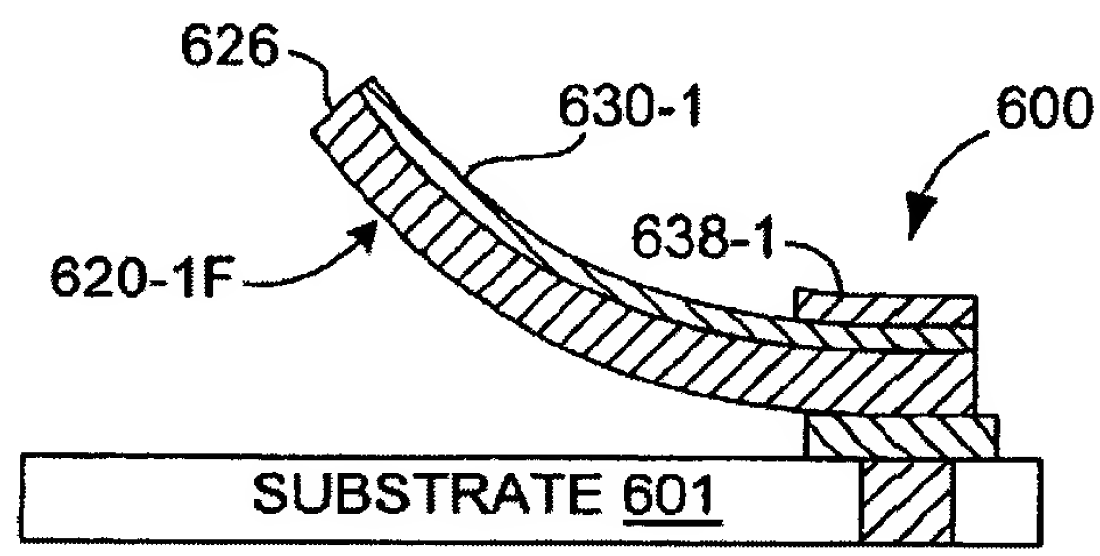

FIG 6(H)

Similarly, Fork's column 5, lines 25-34 merely discuss the formation of a spring metal layer 320, which corresponds to spring metal finger 620-1F of Fig. 6(H):

5

FIG. **3**(B) shows a spring metal layer **320** formed on release material layer **310** using know processing techniques such that it includes internal stress variations in the growth direction. For example, in one embodiment, spring metal layer **320** is formed such that its lowermost portions (i.e., adjacent to release material layer **310**) has a higher internal tensile stress than an upper portion of spring metal layer **320**, thereby causing spring metal layer **320** to have internal stress variations that cause a spring metal finger to bend upward away from substrate **301** (discussed below). Methods for generating such internal stress variations in spring metal layer **320** are taught, for example, in U.S. Pat. No. 3,842,189 (depositing two metals having different internal stresses) and U.S. Pat. No. 5,613,861 (e.g., single metal sputtered while varying process parameters), both of which being incorporated herein by reference. In one embodiment, which utilizes a 100 nm Ti release material layer, spring metal layer **320** includes MoCr sputter deposited to a thickness of 3 microns. In other embodiments, an Mo spring metal layer can be formed on Si or Ti release material layers.

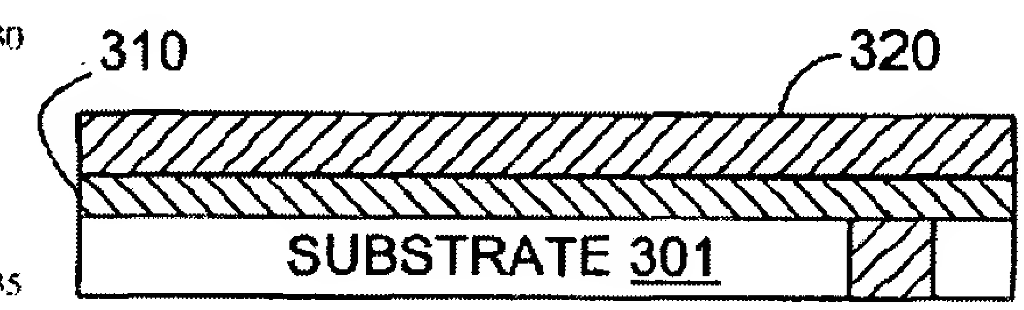

FIG 3(B)

The above text and associated figures clearly fail to even remotely suggest a "stress balancing pad" having an internal stress gradient, let alone a "stress balancing pad" formed such that "the stress-balancing pad has a second internal stress gradient that is opposite to the first internal stress gradient", as recited in Claim 1.

Moreover, as previously pointed out by Applicants, Fork specifically teaches that plated metal portion 638 is formed using a "known plating process" (column 9, lines 30-33), which do not generate stress gradients.

For at least the above reasons, the original rejection of Claim 1, which is repeated in the present Office Action, is respectfully traversed, and should be withdrawn.

Improperly Entered New Argument

The pending Office Action addressed Applicants' previous response by introducing a new basis for rejection that was not previously raised. The new argument is entered on page 2 of the pending Office Action, and is highlighted below:

> The Office Action filed in Paper No. 6 pointed out that the reference indicates that the metal spring consists of different gradients formed there in, (Fork et al. Col. 5 Lines 25-34), in which one of the gradients formed in the metal spring has a resulting vector away from the substrate. The Office Action also points out that the second gradient has a resulting vector the opposite of the first gradient, (Fork et al. Col. 9 Lines 62-63), in which the disclosure states the metal spring remains secure to the substrate. It is inherent by these disclosed statements in Fork et al. that the gradients would be the opposite otherwise the metal spring would pull away from the substrate, just as the first gradient area of the metal spring does as seen in Fork et al.'s Figure 3g. The 35 US.C 102(e) rejection will stand as is.

The quoted text enclosed in the box (above) introduces new grounds for rejection because the originally stated rejection did not even remotely discuss the so-called "inherent" characteristics of plated metal portion 638-1. That is, the original rejection (provided below for reference) specifically

argues that the plated metal portion 638-1 has a "second internal stress gradient":

> ...a stress-balancing pad, (Figure 6 #638-1), formed on the anchor, (Figure 3 #322), portion of the spring metal finger, (Figure 3 #3 20), wherein the stress-balancing pad, (Figure 6 #638-1), has a second internal stress gradient, (Col. 9 Lines 62-63, where the stress-balancing pad is secured to the substrate and has the opposite stress gradient than the spring metal finger, which the spring metal finger pulls away from the substrate and can be seen in Figure 6), that is opposite to the first internal stress gradient, (Col. 5 Lines 25-34). (Office Action, page 3).

Applicants contend that the Examiner's reference to the "inherent" characteristics of plated metal portion 638-1 constitutes new grounds for rejection, and as such the finality of the present Office Action is improper. Should the Examiner maintain the present rejection, Applicants' respectfully request that the pending Office Action be re-classified as non-final.

Even if raising the new rejection is proper, Applicants traverse the new rejection because the Examiner is clearly incorrect in his assertion that "the gradients would be the opposite otherwise the metal spring would pull away from the substrate". Applicants' specification clearly indicates, with reference to prior art structures, that the anchor portions of conventional spring metal fingers are secured to the underlying substrate, but that over time these connections can be weakened:

> A typical spring includes a spring metal finger having a flat anchor portion secured to a substrate, and a curved claw extending from the anchor portion and bending away from the substrate. (Paragraph 0002, page 1, mid-page.)

> The present inventors recognized that most failures of spring structures (e.g., separation of the spring structure from an underlying substrate through delamination or peeling) occur a significant amount of time after fabrication. The present inventors believe these failures are caused at least in part by the internal stress gradient retained in the anchor portion of the spring metal finger. That is, although the internal stress is essentially relieved in the claw of the spring metal finger upon release, the internal stress is retained in the anchor portion of the spring metal finger, along with other "trace" or unreleased portions of the spring metal layer. Over time, this retained internal stress is believed to bend the edges of the anchor portion upward (i.e., away from the underlying substrate), thereby causing delamination or peeling that weakens the attachment of the spring metal finger to the substrate. (Paragraph 3, page 2.)

The above-quoted text clearly indicates that prior art spring structures remained connected to an underlying substrate without the use of a stress-balancing pad. What this passage expresses, in other words, is that peeling does not occur until the stresses concentrated at the interfaces of the anchor portion can overcome the adhesion of the release layer to the substrate and/or spring. Within a regime of limited spring stiffness and compression, the adhesion is large enough to resist such stresses. It is fallacious to conclude that the anchor would pull away from the substrate without stress balancing layers, because this conclusion ignores the presence of interface adhesion. Stress balancing layers simply extend the regime of stiffness and compression that may be achieved.

Moreover, Fork in fact teaches away from the Examiner's apparent argument that a stress balancing layer is necessary in that Fork discloses spring structures that do not include the plated metal

portion 638-1 (e.g., see Fork's Fig. 3(G) (reproduced below for reference):

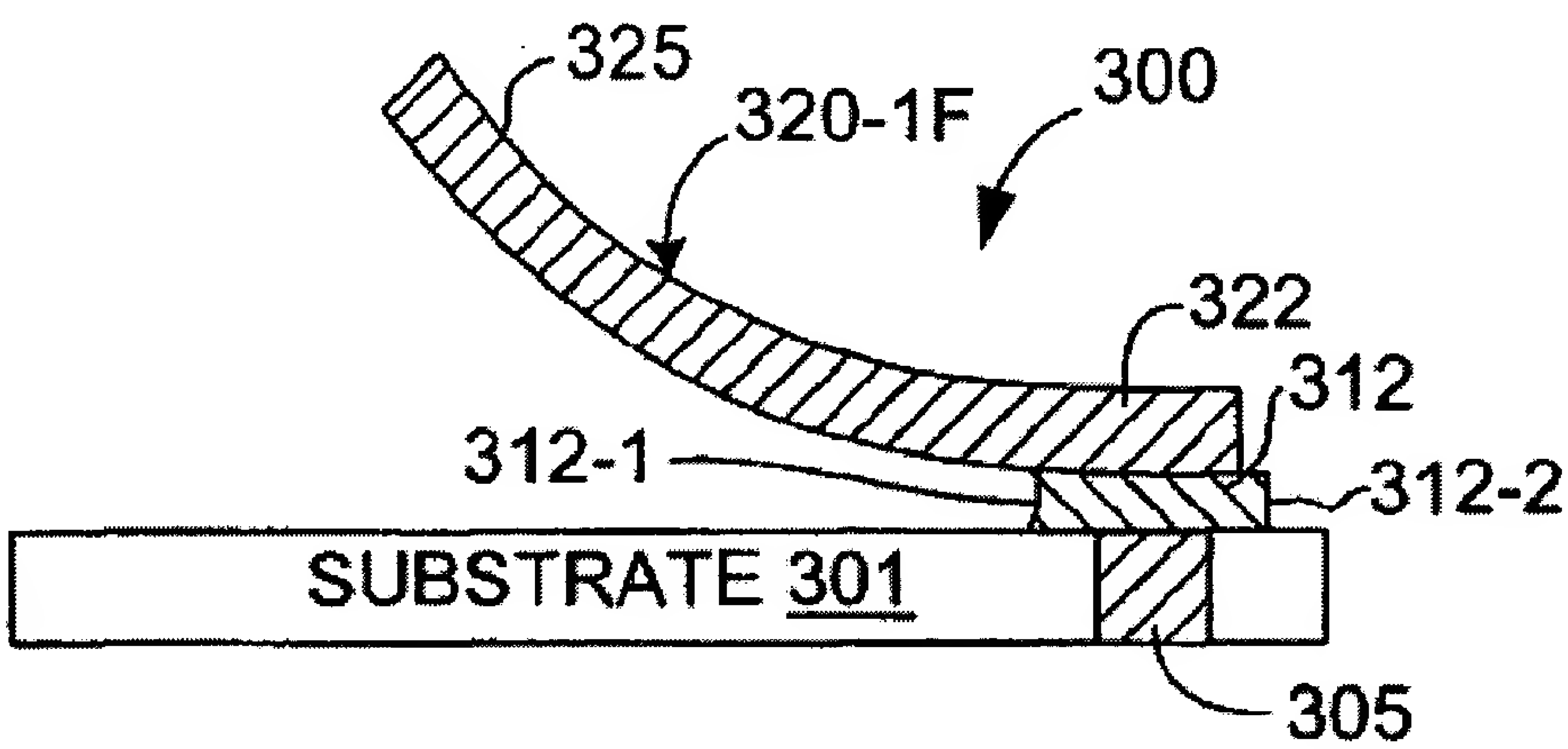

FIG 3(G)

For at least the above reasons, the Examiner's assertion that it "is inherent by these disclosed statements in Fork et al. that the gradients would be the opposite otherwise the metal spring would pull away from the substrate" is not supported by Fork, and therefore should be withdrawn.

For at least the above reasons, Applicant respectfully requests reconsideration and withdrawal of the rejection directed to Claim 1.

Claims 2-9, 12-15, and 17 are dependent from Claim 1, and are distinguished over Fork for at least the reasons provided above with reference to Claim 1.

Claim 18 is rejected for reasons similar to those directed to Claim 1. Similar to Claim 1, Claim 18 recites "wherein the stress-balancing pad is formed from a second stress-engineered material having a second internal moment that opposes to the first internal stress moment". Therefore, Claim 18 is believed